PART –A

1. Arrange the given words in alphabetical order and choose the one that comes last.
   A) Cover B) Collect C) Caught D) Callous

Directions : A foreign expression and four English phrases are given. Identify the meaning of the foreign expression from the choices.

2. per se
   A) By word of mouth B) Gossip
   C) By itself D) Spontaneous

Directions : Identify the meaning of underlined word as used in the sentence, from among four alternatives.

3. The presence of hawkers on footpaths hinders both pedestrian and vehicular movement.
   A) buyers B) vendors C) beggars D) rag pickers

Directions : An idiom and four possible meaning are given, identify the meaning of the idiom from among the answer choices.

4. A man of the world
   A) highly trust worthy B) very popular because of success
   C) a man of wit or genius D) highly experienced in many fields

Directions : Fill in the blanks in the given sentence to make it logically and grammatically correct.

5. Farmers know that changing winds _____ rain or drought.
   A) bring B) create C) form D) present

Directions : A sentence is written in four different forms. Only one of them is grammatically correct. Choose the correct sentence as your answer.

6.
   A) Each of the participants were given a gift
   B) Everyone of the participants were given a gift
   C) All of the participants was given a gift
   D) Each of the participants was given a gift

Directions : Four alternative substitutes are given for the underline portion. Identify the choice that replace the underline part to form a logical and grammatically correct statement.

7. I am hoping to see you again tomorrow at the party.
   A) I am hoping to see you B) I may have seen you
   C) I have been seeing you D) I hope to see you

Directions : A word and four jumbled choices are given. One of the choices, when properly arranged, give the meaning of the word. Identify the correct choice.

8. BUSY
   A) EOTRPY B) URDOO
   C) DSTIOINSURU D) AGLEN

Directions : From the choices, select the most suitable synonym for the main word.

9. ADEPT
   A) devious B) wily C) clumsy D) dexterous

Directions : From the choices, select the most suitable antonym for the main word.

10. ELUCIDATE
    A) impart B) inflame C) excite D) baffle

Directions : There is a certain relation between two given words on one side of : : and one word is given on another side of : : while another word is to be found from the given alternatives, having the same relation with this word as the given pair has. Select the best alternative.

11. Acting : Theatre : : Gambling : ?
    A) Casino B) Club C) Bar D) Gym

Direction s : There is a certain relation between two given numbers on one side of : : and one number is given on another side of : : while another number is to be found from the given alternatives , having the same relation with this number as the given pair has. Select the best alternative.

12. 25 :125 : : 36 : ?
    A) 206 B) 216 C) 226 D) 318

Directions : In the given question, four words have been given, out of which three are alike in some manner and the fourth one is different. Choose out the odd one.

13.
    A) Titan B) Mercury C) Earth D) Jupiter

Directions : In the given question, four numbers are given. Out of these, three are alike in a certain way but the rest one is different. Choose the one which is different from the rest three.

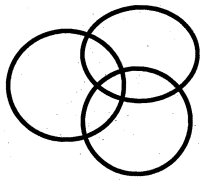
14.
    A) 324 B) 244 C) 136 D) 352

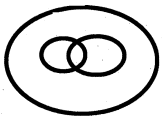
Directions : In the given question, a number series is given with one term missing. Choose the correct alternative that will continue the same pattern.

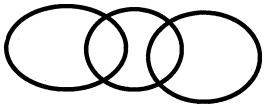
15. 5,9,17,29,45, (……)
    A) 60 B) 65 C) 68 D) 70

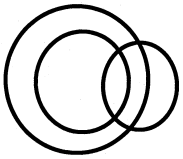
16. If in a certain language, POPULAR is coded as QPQVMBS, which word would be coded as GBNPVT ?
    A) FAMOSU B) FAMOUS C) FASOUM D) FOSAUM

17. Which of the following diagrams correctly represents Cricket, Players, students ?

A) 

B) 

C) 

D) 

18. Find the number which when multiplied by 15 is increased by 196.
A) 14 B) 20 C) 26 D) 28

19. Rs. 1210 were divided among A, B, C so that A : B = 5 : 4 and B: C = 9 : 10 then, C gets
A) Rs. 340 B) Rs. 400 C) Rs. 450 D) Rs. 475

20. If 11.25 meter of a uniform iron rod weighs 42.75 kg, what will be the weight of 6 meter of the same rod ?
A) 22.8 kg B) 25.6 kg C) 28 kg D) 26.5 kg

21. A train 132 meter long passes a telegraph pole in 6 seconds. Find the speed of the train.
A) 70 km/hr B) 72 km/hr C) 79.2 km/hr D) 80 km/hr

22. The Travel and Tourism Competitiveness Index (TTCI) is released by
A) IMF B) World Bank
C) World Economic Forum D) UNCTAD

23. Scientists have discovered a protein that can make vaccinations more effective and provide protection from disease such as cancer. The protein is
A) Guanine B) Tryptophan C) Peptide P D) Por B

24. 'Bhoorsingh the Barasingha' is the Mascot of
A) Kanha Tiger Reserve B) Ranthambhore Tiger Reserve
C) Pench National Park D) Madhumalai National Park

25. Who has recently become the first Woman Field Officer in the Border Security Force (BSF) ?
A) Ms. Tanushree Pareek B) Ms. Vahini Singh
C) Ms. Roopa Rathore D) Ms. Arundhati Bhattacharya

26. Which of the following is not correct ?
    A) Research refers to a search for new knowledge
    B) Research is an art of scientific investigation
    C) Research is defined as a systematized effort to gain new knowledge
    D) Research means searching the same fact again and again

27. Which of the following is correct ?
    A) The main aim of a research is to find out the hidden truth
    B) The foremost objective of a research is to verify the known truth
    C) The main purpose of a research is to conduct investigations only in scientific areas
    D) The chief objective of a research is to know more about nonscientific fields

28. Which of the following is not correct as a motivation in research ?
    A) To enhance educational qualifications
    B) To face the challenges in solving the unsolved problems
    C) To make more money
    D) To get intellectual satisfaction

29. Which of the following is not a type of research ?
    A) Descriptive vs. Analytical
    B) Applied vs. Fundamental
    C) Explanatory vs. Non-explanatory
    D) Quantitative vs. Qualitative

30. The quantitative approach to a research includes
    A) Inferential approach
    B) Experimental approach
    C) Simulation approach
    D) A, B, and C

31. Research has its special significance in solving various operational and planning problems of
    A) Business B) Industry C) Agriculture D) A', 'B' and 'C'

32. Research methods and research methodology represent
    A) The same thing
    B) The two different issues
    C) The related issues
    D) None of the above

33. Research methods include
    A) Methods for collecting the required data
    B) Methods for finding relationship between the data and the unknowns
    C) Methods for evaluating the accuracy of the results derived
    D) All of the above

34. Research methodology consists of
    A) Research methods
    B) Assumptions of research methods
    C) Relevance of the research methods
    D) All the above

35. Research process begins with
    A) Formulation of the research problem
    B) Literature review
    C) Development of working hypothesis
    D) Preparing the research design

36. Research process ends at
    A) Data collection
    B) Data analysis
    C) Preparation of the report or the thesis
    D) Hypothesis testing

37. A working hypothesis is defined as
    A) Central point of conclusion
    B) Tentative assumption about the target population
    C) Literature review
    D) None of the above

38. A null hypothesis denotes
    A) The neutral hypothesis
    B) No hypothesis
    C) The desired hypothesis
    D) B or C

39. Research design aims at
    A) Conceptual structure within which research would be carried out
    B) Formulation of strategy for drawing conclusion
    C) The data collection stage
    D) The preparation of report

40. Population means
    A) A group of objects having some common characteristics
    B) Number of persons living in a place
    C) Number of only citizens of a country
    D) Only children of a country

41. A sample represents
    A) A part of a population
    B) A smaller part that represents a population
    C) Only a smaller part of a population
    D) None of the above

42. A sample design is
    A) A definite strategy for selecting a sample from a given population
    B) Decided after the data collection
    C) Not important for the data collection
    D) A or B

43. A sample size is denoted by
    A) N B) n C) α D) β

44. A population size is represented by
    A) n B) μ C) N D) α

45. A sampling method could be based on
    A) Probability B) Without the concept of probability
    C) Either 'A' or 'B' D) Neither 'A' nor 'B'

46. Simple random sampling is a method of
    A) Probability sampling B) Non-probability sampling
    C) Both 'A' and 'B' D) Neither 'A' nor 'B'

47. Quota sampling is a method of
    A) Probability sampling B) Non-probability sampling
    C) Both 'A' and 'B' D) Neither 'A' nor 'B'

48. Usually an experiment is conducted in a laboratory following
    A) Latin square design B) Randomized block design
    C) Completely randomized design D) None of the above

49. In a survey schedules are used when the replies of the questions are entered by
    A) Investigators B) Respondents
    C) Both 'A' and 'B' D) Neither 'A' nor 'B'

50. In a survey questionnaires are used when the replies of the questions are entered by
    A) Investigators B) Respondents
    C) Both 'A' and 'B' D) Neither 'A' nor 'B'

PART – B

51. The equation $np = n_i^2$ (where n is the concentration of free electrons, p the concentration of holes and n_i, the intrinsic charge carrier density) is valid

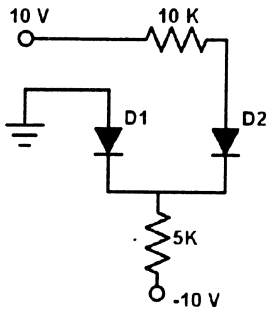
A) only for intrinsic semiconductors

B) only for extrinsic semiconductors

C) for both intrinsic and extrinsic semiconductors

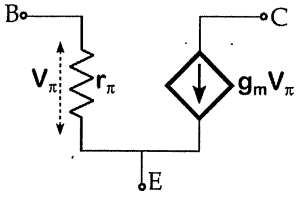
D) only for metals

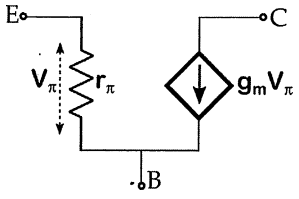
52. The current through D_2 in the following circuit, assuming ideal diode model is

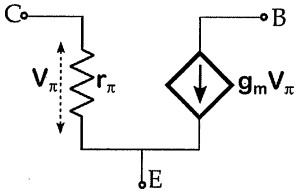


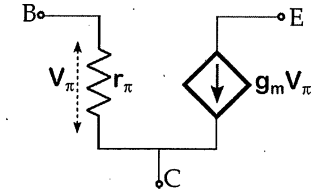
A) 0.7 mA B) 100 mA C) 1mA D) 10 mA

53. Which of the following figures correctly depict the small signal model of a NPN BJT amplifier ?

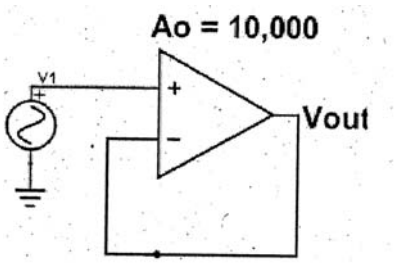
A)


B)


C)


D)


54. The circuit shown below works as a



A) Rectifier
B) Inverting amplifier
C) Logarithmic amplifier
D) Unity gain buffer

55. The number of address (select) lines required for a 16 : 1 multiplexer is

A) 4
B) 8
C) 16
D) 32

56. What is the approximate voltage resolution that can be achieved using a 16 bitADC with a dynamic range of 5V ?

A) 80 μV
B) 0.08 μV
C) 152 μV
D) 152 mV

57. The mean of a set of 40 measurements is given to be 1.022 cm with a spread of 0. 01 cm. The experiment is repeated with a better instrument in which 10 measurements are made yielding a mean of 1.018 cm with a spread of 0.004 cm. What is the mean of all the observations put together ?

A) 1.6458 cm
B) 0.8410 cm
C) 1.5310 cm
D) 1.0196 cm

58. The de Broglie wavelength of a ball of mass 1.0 kg, moving at a speed of 10 m/sec is

A) 6.6×10^{-25} m
B) 6.6×10^{-35} m
C) 0.15×10^{34} m
D) 0.15×10^{35} m

59. The famous experiment by Davidson and Germer proved the

A) The wave nature of electrons
B) Existence of photoelectric effect
C) Quantization of light quanta
D) Raman effect

60. The speed of an electron ($m = 9.1\times10^{-28}$g) is 300 m/sec with an uncertainty of 0.01%. What is the uncertainty in the position if it is measured simultaneously with the speed ?

A) 0.3×10^{-28} m
B) 0.3×10^{-32} m
C) 0.2 cm
D) 2.0 cm

61. Which one of the following potentials yields a finite number of bound states ?

A) Finite square well
B) Infinite square well
C) Harmonic oscillator
D) Zero potential (i.e free particle)

62. The ground state of an isotropic three-dimensional harmonic oscillator is

A) $\frac{3}{2}\hbar\omega$
B) $\frac{1}{2}\hbar\omega$
C) 0
D) $3\hbar\omega$

63. The commutation relation $[L_z, x]$ is equal to

A) $-i\hbar x$
B) $-i\hbar z$
C) $i\hbar y$
D) $i\hbar L_z$

64. A spin 1/2 particle is in the state $\psi = \frac{1}{\sqrt{6}}\begin{pmatrix}1\\ \sqrt{5}\end{pmatrix}$. On a measurement of Sz, what is the probability to get $\hbar/2$?

A) $\frac{5}{6}$
B) $\frac{1}{6}$
C) $\frac{1}{\sqrt{6}}$
D) $\frac{\sqrt{5}}{\sqrt{6}}$

65. Which one of the following is not a relativistic wave equation ?

A) Dirac equation
B) Schrödinger equation
C) Klein-gordon equation
D) Proca equation

66. The strangeness of neutron is

A) -1 B) 1

C) 0 D) 2

67. Weak interactions are mediated by

A) Pions B) Gravitons

C) Photons D) W or Z bosons

68. In special relativity, the ratio p/E is given by

A) v/c B) c/v

C) v/c^2 D) m/c^2

69. The eigen values of the matrix $\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ are

A) 0, 1 B) $\cos\theta, \sin\theta$

C) $e^{\pm i\theta}$ D) $\cos\theta, -\sin\theta$

70. A vector is a tensor of rank

A) 0 B) 3

C) 2 D) 1

71. The Laplace transform of the function $f(t)=e^{at}$ is

A) $\frac{1}{s-a}$ B) $\frac{1}{a-s}$

C) $\frac{1}{s}$ D) $\frac{1}{a}$

72. If A is a non-singular matrix, then the eigen values of A^{-1} are

A) the same as those of A B) not defined

C) the reciprocals of those of A D) different from those of A

73. The zeros of sin(z) are

A) always real B) always imaginary

C) always zero D) always negative

74. The value of $\oint_C dz/(z-a)$, where $z=a$ is inside any simple curve C, is

A) π B) $2\pi i$

C) 0 D) i

75. The series $\sum_{n=2}^{\infty} \frac{1}{n^2-1}$ is

A) Zero B) Oscillatory

C) Divergent D) Convergent

76. The electric field inside a spherical shell of radius R and surface charge density σ is

A) Zero B) Infinity

C) Unity D) Positive

77. Consider a long solenoid of radius b with n_2 turns per unit length. Another solenoid with a smaller radius a and n_1 turns per length is inserted inside the bigger one so that they are coaxial along the z axis. What is B between the two solenoids assuming the two carry current in opposite directions and such that the field due to the outer one points towards $-z$?

A) $-\mu_0 I(n_1 - n_2)\hat{z}$ B) 0

C) $-\mu_0 In_2\hat{z}$ D) $\mu_0 I(n_1 - n_2)\hat{z}$

78. Which one of the following conditions is used for the Lorentz gauge ?

A) $\nabla . A = -\frac{1}{\mu_0}\frac{1}{\epsilon_0}\frac{\partial V}{\partial t}$ B) $\nabla . A = 0$

C) $\nabla . A = -\mu_0 \epsilon_0 \frac{\partial V}{\partial t}$ D) $\nabla . A = -\mu_0 J$

79. The extra term that Maxwell introduced in Ampere's law $\left(\text{i.e.} \epsilon_0 \frac{\partial E}{\partial t}\right)$ is called as

A) Conduction current B) Displacement current

C) Ampere current D) Faraday current

80. The electric field parallel to a wire of length L and radius r is given as V/L. Suppose a current I flows through the wire, the magnitude of Poynting vector near the surface of the wire is given as

A) $\frac{VI}{2\pi r}$ B) $\frac{L}{VI}$

C) $\frac{2\pi rL}{VI}$ D) $\frac{VI}{2\pi rL}$

81. If the initial value of the magnetic field inside a perfectly conducting waveguide is zero, what is it at a later point of time ?

A) Zero B) Infinity

C) B/4t D) $1/4\,\pi$

82. The distance between successive planes for a cubic lattice with a as length of cell edge and miller indices (hkl) is given by

A) $\frac{a}{\left(h^2+k^2+l^2\right)}$ B) $\frac{a}{\left(h^2+k^2+l^2\right)^{0.5}}$

C) $\frac{a^2}{\left(h^2+k^2+l^2\right)^2}$ D) $\frac{\sqrt{a}}{\left(h^2+k^2+l^2\right)^2}$

83. The resistivity of Cu at room temperature is $1.78 \times 10^{-18}\ \Omega$ m. What is the mean free path of the conducting free electrons assuming the lattice parameter to be 3.61 $\mathring{A}$?

A) 6.14 $\mathring{A}$ B) 12.14 $\mathring{A}$

C) 3.61 $\mathring{A}$ D) 1.21 $\mathring{A}$

84. The effective mass of Bloch electrons is given by

A) $\hbar(dE/dk)$ B) $\hbar^2/(d^2E/dk^2)$

C) $(d^2E/dk^2)/\hbar^2$ D) $(dE/dk)/\hbar^2$

85. If N is number of unit cells in the crystal, the number of allowed k-states in a band of a three-dimensional simple cubic lattice is equal to

A) $1/N^2$ B) $1/N$

C) N^2 D) N

86. The Lande interval rule states that the energy of adjacent levels of a multiplet is

A) Differ by unity

B) Zero

C) Inversely proportional to the total angular momentum quantum number of the level of higher energy

D) Proportional to the total angular momentum quantum number of the level of higher energy

87. The ratio of the number of molecules in rotational level r with degeneracy N_r to the number in $r = 0$ rotational level with degeneracy N_0 is given by

A) $\frac{1}{N_0 N_r} e^{(E_r - E_0)/kT}$ B) $\frac{N_0}{N_r} e^{(E_r - E_0)/kT}$

C) $\frac{N_r}{N_0} e^{(E_0 - E_r)/kT}$ D) $\frac{N_0}{N_r} e^{(E_0 - E_r)/kT}$

88. The ratio of number of antisymmetric spin states to the number of symmetric spin states in a nucleus with spin angular momentum quantum number i is

A) $\frac{2(i+1)}{i}$ B) $\frac{2i}{i+1}$

C) $\frac{i}{i+1}$ D) $\frac{i+1}{i}$

89. A system of atoms in thermal equilibrium emit and absorb photons with energy of 2eV. The ratio of the transition rates of stimulated emission to spontaneous emission at a temperature of 300K is

A) $1.8 \times 10^{+35}$ B) 1.8×10^{-32}

C) 1.8×10^{-25} D) 1.8×10^{-35}

90. The resonator modes for which $n = m = 0$ are called as

A) Axial modes

B) Non-axial modes

C) Higher-order transverse modes

D) Lower-order transverse modes

91. The change in entropy due to an adiabatic irreversible process in an isolated system is

A) Zero

B) Greater than zero

C) Less than zero

D) Either positive or negative

92. A one-dimensional system of length L consists of 7 non-interacting spin 5/2 particles of mass m .If the system is in its ground state, then the energy required to take the system to its first excited state is

A) $4h^2/8mL^2$

B) $5h^2/8mL^2$

C) $6h^2/8mL^2$

D) $7h^2/8mL^2$

93. Which of the following is correct ?

A) $\left(\frac{\partial T}{\partial p}\right)S, N = \left(\frac{\partial V}{\partial S}\right)p, N$

B) $\left(\frac{\partial S}{\partial p}\right)T, N = \left(\frac{\partial V}{\partial T}\right)p, N$

C) $\left(\frac{\partial V}{\partial N}\right)T, N = \left(\frac{\partial \mu}{\partial S}\right)p, N$

D) $\left(\frac{\partial T}{\partial S}\right)p, N = \left(\frac{\partial V}{\partial p}\right)S, N$

94. Which of the following statements is correct ?

A) Gibbs paradox arises because of finite volume occupied by particles in a gas

B) Gibbs paradox arises because the energy of the particles in a classical gas are not quantized

C) Statistical mechanics fails to explain the Gibbs paradox in classical gases

D) Gibbs paradox arises because of distinguishability of particles

95. Consider a mass m on the end of a spring of natural length l and spring constant k. Let y be the vertical coordinate of the mass as measured from the top of the spring. Assume the mass can only move up and down in the vertical direction. The general solution will be

A) $y = i + A\sin(\omega t)$

B) $y = mg/k + A\cos(\omega t)$

C) $y = i + A\sin(\omega t) + mg/k + B\cos(\omega t)$

D) $y = i + A\sin(\omega t) + mg/k$

96. A particle of charge e and mass m moves in electric and magnetic fields given by scalar potential ϕ and vector potential $\vec{A}$. If the Lagrangian of the particle is given by $L = \frac{1}{2m} v^{\rightarrow 2} + e\vec{A} - e\phi$ then,

A) The Hamiltonian of the particle is given by $H = \frac{\vec{p}^{\,2}}{m} + \frac{e}{m}\vec{A}.\vec{p} - e\phi$

B) The Hamiltonian of the particle is independent of potentials

C) Lagrangian of the particle changes by the total time derivative under a gauge transformation of the potentials

D) The conjugate momentum of the particle is given by $m^{\vec{v}}$

97. Which of the following will not be present for a fluid in space (zero gravity)

A) Viscous force

B) Surface tension

C) Pressure

D) Buoyancy force

98. Two satellites of mass m and 4 m are in circular orbits of radii R and 4R around a planet, respectively. Their period of revolution are related by

A) 1 : 1

B) 1 : 2

C) 1 : 4

D) 1 : 8

99. For the Kepler problem, if $\vec{p}$ is the linear momentum, $\vec{L}$ is the angular momentum, m is the mass k is the constant of inverse square law force, which one of the following statements is correct

A) $\vec{p} \times \vec{L} - mk\frac{\vec{r}}{r}$ is a constant of motion

B) Only $\vec{L}$ is a constant of motion

C) $\vec{p} \times \vec{L}$ is a constant of motion

D) $\vec{p}$ is a constant of motion

100. For an ideal Bose gas, which of the following is correct ?

A) Specific heat at constant volume is constant near characteristic temperature

B) Specific heat at constant volume is linearly proportional to temperature near characteristic temperature

C) Specific heat at constant volume takes maximum value at characteristic temperature

D) Specific heat at constant volume takes minimum value at characteristic temperature

---

SPACE FOR ROUGH WORK